

Notice of Allowability

Application No.

10/699,955

Examiner

Emmanuel Sayoc

Applicant(s)

DAVIS ET AL.

Art Unit

3746

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☒ This communication is responsive to application filed 11/03/2003.
2. ☒ The allowed claim(s) is/are 1-20.
3. ☒ The drawings filed on 03 November 2003 are accepted by the Examiner.
4. ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some* c) ☐ None of the:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

* Certified copies not received: _____.

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.

THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.

5. ☐ A SUBSTITUTE OATH OR DECLARATION must be submitted. Note the attached EXAMINER'S AMENDMENT or NOTICE OF INFORMAL PATENT APPLICATION (PTO-152) which gives reason(s) why the oath or declaration is deficient.
6. ☐ CORRECTED DRAWINGS (as "replacement sheets") must be submitted.
- (a) ☐ including changes required by the Notice of Draftsperson's Patent Drawing Review (PTO-948) attached
- 1) ☐ hereto or 2) ☐ to Paper No./Mail Date _____.
- (b) ☐ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date _____.
- Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).
7. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

Attachment(s)

1. ☒ Notice of References Cited (PTO-892)
2. ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3. ☒ Information Disclosure Statements (PTO-1449 or PTO/SB/08),
Paper No./Mail Date 12/08/2003
4. ☐ Examiner's Comment Regarding Requirement for Deposit
of Biological Material
5. ☐ Notice of Informal Patent Application (PTO-152)
6. ☒ Interview Summary (PTO-413),
Paper No./Mail Date 08/19/2003.
7. ☒ Examiner's Amendment/Comment
8. ☒ Examiner's Statement of Reasons for Allowance
9. ☐ Other _____.

EXAMINER'S AMENDMENT

1. An examiner's amendment to the record appears below. Should the changes and/or additions be unacceptable to applicant, an amendment may be filed as provided by 37 CFR 1.312. To ensure consideration of such an amendment, it MUST be submitted no later than the payment of the issue fee.

The application has been amended as follows:

The title is changed with, "A Pump with an Electrodynamically supported impeller and a Hydrodynamic Bearing Between the Impeller and the Stator."

In Claim 1, line 10, the phrase "for generating a" is replaced with -- structured to generate a --.

REASONS FOR ALLOWANCE

2. The following is an examiner's statement of reasons for allowance: the prior art neither discloses nor makes obvious the combination set forth in the claims by not disclosing a pump comprising a stator, a plurality of permanent magnetic elements forming bearing poles coupled to a selected one of the stator and the impeller, and a plurality of shorted coils coupled to the other of the stator and the impeller, wherein the plurality of bearing poles and shorted coils co-operate to form an electrodynamic bearings during rotation of the impeller. The prior art individually or in combination do not teach combining the electrodynamic bearing with a pump and in particular at a location between the impeller and stator. Furthermore the prior art individually or in combination does not teach a hydrodynamic surface structured to generate a hydrodynamic bearing between the impeller and the stator.

Electrodynamic bearings are termed by the applicant to embody bearings that use permanent magnets in conjunction with coils that do not receive any external power or control. The coils are shorted and the movement of the permanent magnet induces current. Electrodynamic bearings are to be distinguished from permanent bearings, sometimes termed as passive magnetic bearings, where the bearings involve only permanent magnets, no coils or electromagnetic fields. Electrodynamic bearings are also to be distinguished from active magnetic bearings that contain coils and sometimes permanent magnets. The coils are powered by external power sources in order to produce an electromagnetic field and often require control algorithms.

In alternative embodiments, the claimed invention features a plurality of permanent magnets arranged in a highly efficient magnetic pole arrangements called a Halbach array. The permanent magnet may also be one integral piece of differently directed magnetic polarities. The electrodynamic suspension concept is used as a bearing and as a drive means for the pump which comprises motor poles. Motor and bearing poles may be integrated on one permanent magnet.

Watterson et al. (U.S. 6,227,797 B1) is cited for teaching a hydrodynamically suspended impeller. There is not teaching of combining an electrodynamic bearing.

Tsumaki et al. (U.S. 4,579,508) teaches a pump with a conventional active or passive bearing and a hydrodynamic bearing for thrust support. There is not teaching of combining an electrodynamic bearing and a hydrodynamic bearing in particular positions as claimed.

Antaki et al. (U.S. 6,015,272) is cited for teaching a pump using only conventional active or passive bearings.

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Becker (U.S. 4,036,565) teaches a pump with what the inventor calls an electrodynamic bearing, however upon closer examination of the specification, the bearing is a conventional active or passive magnetic bearing. There are no shorted coils or the characteristic induced current.

Filatov et al. (U.S. 6,304,015 B1) was cited for disclosing a magneto-dynamic bearing using permanent magnets and coils, which receive no external power or control. There is no motivation for applying this bearing to a pump, and not in the particular pole arrangement specified by the claimed invention.

Clifton et al. (U.S. 5,471,105) is cited for teaching a closed loop (shorted) coil bearing, but there is no teaching of applying the bearing to a pump and in the particular location between the impeller and stator.

Rao (U.S. 5,256,637) was cited for teaching a thrust bearing that uses coils both on the rotor and the stationary housing. The rotor coil is disclosed as being replaceable with a permanent magnet. In contrast the stationary coil is not shorted and is disclosed as receiving a D.C. power. The coil may be shorted after the power is provided in order to increase rotor stiffness.

Auer (DE 32 43 641 A1) was cited for disclosing a rotor with permanent magnets and coils that receive ac power, and are hence, not shorted. The term electrodynamic magnetic bearing is used for one of the bearings but does not disclose the bearing arrangement as in the claimed invention. In any case, the figure shows an A.C. power supply for the coils.

Lembke (WO 98/32981) discloses an electrodynamic bearing with a permanent magnet. Instead of coils, the rotor is made of conductive material. Current and electromagnetic fields are induced upon rotation.

Simonin (WO 99/28626) discloses a pump that is not disclosed as having electrodynamic bearings, but forces fluid circulation by an electrodynamic transducer mobile in translation.

Bichler et al. (U.S. 5,925,952) discloses a magnetically mounted position stabilized flywheel. The device uses permanent magnet and windings. An electrodynamic actuation or force generation system is disclosed that contains a regulation system, which suggests a control algorithm and external power in the windings.

Wampler (US 2002/0102169 A1, U.S. 6,080,133, U.S. 5,840,070) discloses a blood pump comprising a permanent magnet bearing system and a bearing axial bearing system. Pump drive is achieved by inducing current and magnetic fields in the drive windings.

Anataki et al. (U.S. 6,244,835 B1), Jarvik (U.S. 6,227,820 B1), and Goldowsky (U.S. 6,527,699 B1) disclose blood pumps comprising a permanent magnet and active coil bearing system. The active coils receive external power and control signals. Pump drive is achieved by inducing current and magnetic fields in the drive windings.

Lembke (U.S. 6,050,782) actually teaches away from electrodynamic bearings due to overheating of the coils.

The prior art neither individually, nor in combination, fail to anticipate or make obvious the combination of components specified in the claimed invention.

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Essentially electrodynamic bearings are known in the art but the has not been any clear and definite teaching of applying the bearing to an impeller pump in the manner disclosed in the claims.

Any comments considered necessary by applicant must be submitted no later than the payment of the issue fee and, to avoid processing delays, should preferably accompany the issue fee. Such submissions should be clearly labeled "Comments on Statement of Reasons for Allowance."

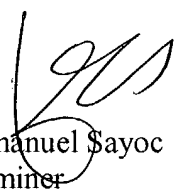
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Contact Information


3. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Emmanuel Sayoc whose telephone number is (703) 305-0054. The examiner can normally be reached on M-F 8 A.M. - 6 P.M..

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Justine Yu can be reached on (703) 308-2675. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).


Emmanuel Sayoc
Examiner
Art Unit 3746

ECS


JUSTINE R. YU
SUPERVISORY PATENT EXAMINER
TECHNOLOGY CENTER 3700
8/20/04